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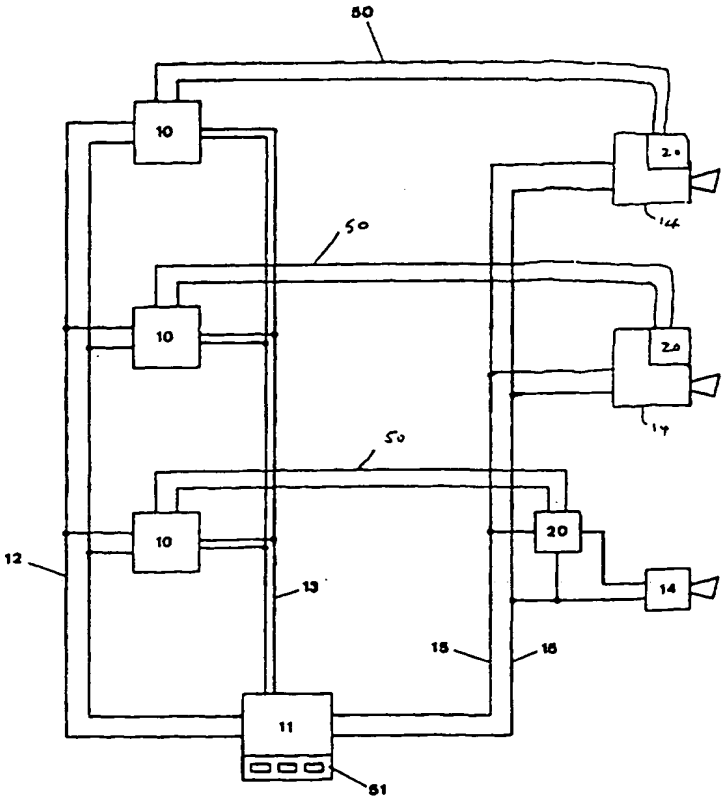
(57) Abstract

A method and apparatus to assist in testing of fire alarms and other emergency warning systems. Such a system typically contains annunciator devices (14) such as sounders, speakers or strobe lights and these must normally be checked for acceptable operation on a regular basis. The invention enables a single or married individual to activate the alarm system briefly, without creating undue disturbance for surrounding occupants of an office or apartment block for example. The individual can then inspect an event recorder (20) located near or integral with each annunciator, to check that the respective annunciator has operated correctly. Operation of the annunciator may be assessed by monitoring input or output of the annunciator, such as current levels, or audible or visible output. Alternatively, each annunciator may communicate an indication of acceptable operation directly to a main control panel (11).



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IMPROVEMENTS RELATING TO EVENT DETECTION AND RECORDAL

BACKGROUND TO THE INVENTION

This invention relates to monitoring of the operation of electrical devices, particularly but not solely low voltage devices such as annunciators which are commonly used in fire alarm or other emergency warning systems.

The invention generally involves event recorders which are fitted to annunciators such as sounders in an existing alarm system, or are provided as integral parts of each annunciator in a new system. This enables the annunciators, which are subject to vandalism, to be tested as generally required by building and safety laws.

In New Zealand various standards require that manual and automatic fire alarm systems be tested regularly. Each alarm sounder in a building must be confirmed as operational on a monthly basis. However, there are some logistical difficulties for building owners who seek to comply with the required tests. Considerable annoyance and inconvenience can be created for tenants in an office block for example, or guests at a hotel. Tests lasting a few minutes or less are often carried out in a hurried and haphazard manner under these circumstances.

The standards suggest that individual fire wardens report to a coordinating person such as the chief building warden if they do not hear the alarm in their vicinity during a test procedure. This requires a stringent regime of coordination and reporting which may not be fulfilled. For example, individual wardens who are absent will not report and their respective alarms will simply be assumed operational, while wardens who are present often do not take their responsibility seriously. It is possible for the sounders in a system to be consecutively checked by a single responsible technician, using either continuous or intermittent activation of the sounders. This creates annoyance as indicated above however, and takes time during which the alarm signals from the main panel are not recognised by the usual monitoring services.

Standards of this kind and the difficulties of their enforcement are common in developed countries.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide for more convenient and reliable testing of sounders or similar devices in a fire alarm system.

Accordingly in a first aspect, the invention may broadly be said to consist in a method of testing an alarm system having annunciator devices such as sounders or speakers, comprising: installing event recorders to monitor at least some of the annunciator devices in the system, activating the system during a test procedure, detecting operation of the monitored devices with the respective event recorders, and inspecting each recorder to determine whether the respective monitored device has operated in an acceptable fashion.

Preferably the event recorders monitor either output strength of the annunciators, such as the audible output of sounders or the visible output of strobe lights, or current flow through the annunciators, or a combination of these. The recorders will generally have internal power supplies, but may alternatively draw and store power from the fire alarm system. In either case, they should have sufficient power available to provide a clear indication of each device's operation, for perhaps an hour or more after the system is activated.

In a second aspect the invention may broadly be said to consist in event recorder apparatus for monitoring the operation of an annunciator device comprising: output detecting means which determines whether output from the device has reached a predetermined level and/or current detecting means which determines whether current flow through the device has reached a predetermined level, and indicating means which provides an at least temporary indication for an observer as to whether the predetermined levels have been reached.

Preferably the event recorder includes a microphone to monitor audible output of the annunciator device, and may be connected in series with the device to monitor current flow through the device. Preferably the recorder also includes an internal power supply, but may also draw current from a supply provided to the device.

In a third aspect the invention may also be said to consist in an annunciator for an emergency warning system, including an event recorder for monitoring operation of the annunciator, wherein the event recorder monitors a physical output of the annunciator and/or current drawn by the annunciator, and generates an indication of whether or not the annunciator has operated acceptably during activation of the emergency warning system.

Preferably the event recorder monitors audible output of the annunciator by way of a microphone, but could also monitor strobe output for example. In one embodiment the event recorder generates a visible indication of acceptable operation of the annunciator,

for inspection at the annunciator itself. In another embodiment the event recorder generates an indication signal which is transmitted to a control panel located elsewhere in the emergency warning system.

In a fourth aspect, the invention may also be said to consist in an emergency warning system having annunciators and event recorders which monitor operation of respective annunciators, wherein the event recorders provide an indication of whether the annunciators have operated acceptably during a test procedure, and either provide their indications for subsequent inspection at the annunciators, or transmit respective indication signals to a control panel.

Preferably the event recorders are integral with respective annunciators, although they may be installed separately near the annunciators. Preferably the event recorders monitor audible outputs of their respective annunciators, and may also monitor other physical outputs, and/or current flow through the annunciators.

Other aspects of the invention will become apparent to a skilled reader from the following description and drawings.

BRIEF DESCRIPTION OF THE FIGURES

Preferred embodiments of the invention will be described with respect to the accompanying drawings, of which:

Figure 1 is a schematic layout of electrical connections for an existing annunciator system, such as a fire alarm system;

Figure 2 is a schematic layout for a system which incorporates an event recorder for each annunciator according to the invention;

Figures 3a and 3b are circuit diagrams showing alternative preferred event recorders which might be used in the system of Figure 2;

Figure 3c is a diagram of an additional circuit for use with ac annunciators;

Figure 4 is a block diagram for a testing device which might be used with the event recorders of Figures 3a or 3b;

Figure 5 is a schematic layout for a further system in which information from each event recorder is transmitted to a main panel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings it will be appreciated that details of the invention are still under development. Various alternative event recorders, and their accompanying testers, may be constructed without departing from the concepts which are summarised above. It will also be appreciated that the invention is described in relation to monitoring and testing of a fire alarm system by way of example only, and may also find use in relation to other emergency warning systems involving remotely positioned annunciators or analogous devices.

Figure 1 shows simplified wiring arrangements in a conventional fire alarm system which might be installed in a building or similar structure. A number of responders 10 are distributed throughout the building, perhaps several on each floor, connected to a main control panel 11 which is typically positioned in a service area on the ground floor or in the basement. The main panel is usually connected to an external monitoring service over the telephone lines. Each responder is connected to a number of manual call points and perhaps other devices such as smoke detectors, which have not been shown. The MCPs are generally well known in the form of small wall-mounted boxes each having a glass cover and a push-button or switch actuator. The responders are typically powered in parallel through low voltage (eg. 12 or 24V) lines 12 from an ac or dc supply in the main panel 11, and communicate with the main panel through a bus 13.

A number of annunciators 14 in the form of speakers, sounders, or strobe lights are also distributed throughout the building, usually close to the MCPs. Each annunciator is typically powered along lines 15 from a low voltage ac or dc supply at the main panel 11, similarly to the responders, or may be separately powered from the main panel. Sounders generate a predetermined output when power is applied and in some cases may require separate communication with the panel. Speakers and equivalent devices in other systems will generally require a communication bus, which has not been shown, to receive audio signals or other complex signals as appropriate. The alarm system may be activated through input from an MCP or smoke detector to an individual responder 10, through the panel 11, or from elsewhere through a connection to the main panel which has not been shown. If the system is in working order the annunciators 14 will each generate an audible output as required, or some other output in other systems. It will be appreciated that the responders may not always be present, however, with the system only being capable of activation from the main panel 11, for example.

Figure 2 shows wiring arrangements in a fire alarm system according to the invention, in which the operation of each annunciator 14 is monitored by an event recorder 20. Once again each annunciator is powered from the main panel 11 along lines 15, although the responders and related equipment which would usually be present have been omitted for clarity. Each event recorder monitors a physical output of the respective annunciator, such as sound or light levels, and/or monitors voltage or current supplied to the annunciator, or a combination of the various parameters. The event recorders are usually powered by an internal power supply such as a lithium battery, but may also be powered from the main panel along lines 15. Monitoring of the annunciator output provides an indication that the device has operated as required during a system test procedure. Monitoring of the current provides an additional or alternative indication that the annunciator has in fact been activated, whether or not it operated satisfactorily. The event recorders are generally able to visibly display the results of their monitoring processes in some fashion, typically by way of light emitting elements such as LEDs, or may transmit a signal to a central control panel as described below.

Installing an event recorder 20 at each annunciator 14 enables the fire alarm system to be tested by an individual, who briefly activates the system, then visits and observes each recorder throughout the building in turn. The recorders are able to indicate at least temporarily, or when required during a visit, whether an activation event has occurred at their corresponding annunciators. A test for satisfactory operation of the annunciators can then be carried out without activating the system for an undue length of time which would annoy people inside the building, and without relying on several observers to simultaneously check and report on respective annunciators. A series of recorders may be installed by way of retrofit to an existing system, or initially when a new system is set up. They can be generally compact and reasonably cheap devices which cause relatively minimal inconvenience during installation and require minimal amounts of power. The operation of each recorder itself must also be checked, and appropriate testing can be carried out using a portable device which applies power to both the annunciator and event recorder simultaneously, as will be described below.

Figure 3a is a circuit diagram for a preferred event recorder according to the invention. The recorder detects physical output from the device which is being monitored, and generates a visible indication for inspection as to whether the device operated acceptably. In this case the device is a sounder in a fire alarm system and the physical output is sound at or above a predetermined loudness. The recorder uses power from the sounder supply when the sounder is activated to monitor the activation and latch whether the activation was effective. When the sounder supply is present and after a satisfactory sound level is

reached, an appropriate display lamp is turned on and remains on after the sounder is deactivated for a predetermined time, typically half an hour to an hour or more. Power for the display lamp is supplied by a long life battery contained within the lamp circuit. The display lamp must remain turned on for sufficient time to enable a person checking the recorder to visit and inspect the lamp to assess the performance of the sounder. If the sounder supply or sounder does not perform properly, or the event recorder is faulty, the lamp will not illuminate.

Positive power is supplied from the main panel to the recorder through the *+ve in* terminal of the *signal connector* T2 and passed on to the sounder through the *+ve out* terminal of T2. A blocking diode D1 is connected between the *+ve in* and *+ve out* terminals of T2. Diode D1 in conjunction with *test connector* T1 provide for the recorder and sounder to be isolated from the main panel power supply for the purpose of localised performance assessment. The test connector T1 incorporates a switch which has one pole connected to the *+ve* terminal of T1, the *+ve out* terminal of T2 and the cathode of D1. The second pole of the T1 switch is connected to the *+ve in* terminal of T2 and the anode of D1. The T1 switch is normally closed unless a plug has been seated in the test connector and switches out the current blocking function of D1. During normal operation the T1 switch retains the main panel wire circuit to the sounder when the recorder is connected and D1 provides a backup power circuit to the sounder should the switch fail. The *-ve* terminals of T1 and T2 are connected together and form a common negative terminal for the main panel, sounder and recorder.

The *+ve* terminals of signal connector T2 provide the positive power source for the event detection part of the recorder circuit. Polarity protection diode D2, current limiting resistor R1, voltage regulator diode D3 along with filter capacitors C1 and C2 form the event detector power supply and are connected across the *+ve* and *-ve* terminals of T2 and T1. These components stabilise the supply voltage and filter out electrical noise for the event detection circuit and limit the power the recorder draws from the main panel.

A microphone M1 for detecting output from the sounder is powered through resistor R2 which limits microphone current and contributes to microphone sensitivity by forming part of the microphone load circuit. Diodes D4, D5 and capacitor C3 connected across the microphone provide non linear loading on the microphone and reduce the signal output from the microphone as sounder loudness increases above the event detect sound loudness threshold. This increases the range of sound loudness the microphone amplifier by Q1, C4, R3, R4, C5 and R5 is capable of amplifying. Sound received by the microphone causes a varying signal voltage to present across the microphone terminals,

which capacitor C4 couples to the amplifier transistor Q1. Capacitor C4 also isolates the amplifier from the microphone direct current supply. Resistors R4 and R5 provide the amplifier output signal resistive load and contribute to setting the voltage amplification across transistor Q1. Resistor R4 is connected to the recorder power supply and provides the power source for transistor Q1 and in conjunction with resistor R3 contribute to setting the direct current state of the amplifier. Resistors R3 and R4 are the primary components in conjunction with the characteristics of transistor Q1, which set the signal and power properties of the microphone amplifier. Capacitor C5 couples the amplified microphone signal to the peak signal detection components D6, R6 and C6 and isolates them from the amplifier direct current circuit.

Diode D6 provides a path for positive current flow through capacitor C6 during cycles of the amplified microphone signal output by transistor Q1. Capacitor C6 stores energy from this current flow resulting in an increase in direct current voltage across C6. During negative parts of the microphone signal cycle, current through D6 ceases and some of the energy stored in C6 flows out of C6 through the discharge resistor R6. The component values of C6 and R6 are arranged so that the direct current voltage across C6 reflects the peak value of the amplified microphone signal. The peak value of voltage across capacitor C6 is monitored by pin 4 of the voltage comparator IC1. This voltage is compared against the event detect reference voltage *Vref1* on pin 3 of IC1. When the voltage across C6 is less than *Vref1*, the output pin 1 of IC1 is approximately the same as the battery B1 voltage. When the voltage across C6 is higher than *Vref1*, the output pin 1 of IC1 is approximately zero or at ground potential. The transition of IC1 output pin 1 from battery voltage to ground is used by C7, R7, R15 and Q2 as the event effective activation trigger. The voltage comparative IC1 is continuously powered by the long life battery B1.

Capacitor C7 is initially charged through resistor R7 and transistor Q2 when the battery B1 is first connected to IC1. Once C7 is fully charged, current ceases to flow through R7 and Q2. Transistor Q2 operates as a switch connected across capacitor C8. When the event trigger signal is provided by IC1 switching pin 1 to ground, the charge stored in C7 is discharged through D7, R7 and R8. While the sounder loudness remains above the effective activation threshold, IC1 holds pin 1 at ground and C7 remains discharged. When the sounder loudness drops below the effective activation threshold, IC1 pin 1 pulls capacitor C7 back up to battery voltage. This causes C7 to recharge drawing current through R7 and Q2. The current flow through Q2 switches the transistor on which discharges the effective activation lamp timing capacitor C8. Once C7 has recharged, the

charging current ceases flow through Q2 and this switches the transistor off. The transistor is then held in the off state by resistor R8.

When transistor Q2 is switched off, the lamp timing capacitor C8 charges up to a voltage approaching the battery B1 voltage through resistors R10 and R9. The values of C8, R10 and R9 are arranged so that the time C8 requires to fully charge is sufficient time to for a person checking the recorder to visit and inspect the lamp to assess the performance of the sounder. The voltage across C8 is monitored by pin 6 of the voltage comparator IC1. The voltage is compared with a reference voltage *Vref2* on pin 5 of IC1. When the voltage across C8 is less than *Vref2*, IC1 sets its output on pin 8 to ground causing current to flow through resistor R11 and lamp D8 causing the lamp to illuminate. When the voltage across C8 rises above *Vref2*, IC1 sets its output on pin 8 to rise to approximately the B1 battery voltage. This causes the current flow through lamp D8 to cease along with illumination. Resistor R11 determines how much current flows through the lamp and this is set at a level which preserves the battery life while ensuring adequate lamp illumination. Jumper J2 can be removed from its default position across resistor R9 to extend the lamp display time by reducing the charge current available to capacitor C8. Extending the lamp illumination time will also reduce the battery life.

The voltage comparators use two reference voltages provided by diodes D9, D10, D11 and resistor R12. Current flow through these diodes and resistor is arranged so that suitable reference voltages are obtained from the component chain. Jumper J3 across diode D10 can be removed to increase the minimum sound loudness level that will be recorded as an effective sounder activation.

Figure 3b is a circuit diagram for an alternative event recorder according to the invention. The recorder detects both load current and physical output from the device which is being monitored, although a record of either parameter would often be satisfactory. In this case the device is a sounder in a fire alarm system and the physical output is sound at a predetermined loudness and pitch. The recorder stores power from the supply when the sounder is activated and is thereby able to indicate whether the activation was effective. When a satisfactory current, sound and/or light output level is reached an appropriate display lamp is turned on and remains on after the sounder is deactivated until the stored power supply is exhausted. Sufficient power must be stored to enable a person checking the recorder to visit and inspect the lamps to assess the performance of the sounder. An internal power supply may also be provided. Alternatively the lamps can turn off until the person arrives and operates a manual control on the recorder which will illuminate the

lamps using the stored power. If the sounder does not perform properly then the lamps will not illuminate.

Positive power is supplied from the main panel to the recorder through terminal T2 and a blocking diode D1 before passing to the sounder through terminal T1. A fuse F1 and current limiting resistor R0 lead to a voltage regulator VR1. This regulates the supply to 12V and through diode D2 provides a positive supply point S at 11.5V. Current from this point passes to a microphone circuit through resistor R1, to a capacitor storage and an op-amp circuit through diode D5, or to the op-amp reference circuit through resistor R2 as required. The op-amp circuits include amplifiers A1 and A2 which monitor current and sound levels respectively. Either or both may be used in an event recorder according to the invention. These circuits are similar and will be described briefly below although their operation and adaptation for use in other recorders should be generally self explanatory.

A microphone M1 for detecting output from the sounder is powered through a sensitivity control P1 and current limiting resistor R1. Sound received by the microphone causes a varying impedance and generates an alternating voltage. A dc voltage blocking capacitor C1, divert resistor R3 for negative going currents, and rectifying diode D3 generates direct current. A smoothing capacitor C4, with bleed resistor R4, passes this current through blocking diode D4 and resistor R7 to generate a voltage at the positive input of op-amp A2. The current magnitude is controlled by P1 and R7 at an appropriate level for the op-amp. If the positive input voltage is greater than the negative input voltage then the op-amp will generate a positive going output voltage and consequently a current flows from source I2 to illuminate lamp L2. Resistors R10 and R11 determine the current through the lamp and a minimum hold current through terminals T6 and T7 which will be explained below. Current from the illuminated lamp passes the positive input of the op-amp and latches the lamp on.

Load current through the sounder also passes through the recorder by way of terminals T3 and T4, and a resistor network R12 and R13. Terminals T4 and T5 may or may not be connected depending on whether the main panel provides a 12V or 24V supply. Approximately 0.5V appears across T3 and T4 when the sounder is activated, with the recorder being protected by fuse F2, and a sensitivity adjustment being provided by potentiometer P2. Current passes through diode D6 and resistor R6 to create a voltage at the positive input of op-amp A1. When this voltage is greater than that applied to the negative input the op-amp will generate a positive going output voltage and consequently a current flows from source I1 to illuminate lamp L1. Resistors R8 and R9 determine the

magnitude of current through the lamp and a minimum hold current which will be explained below. Current from the illuminated lamp passes through resistor R6 and latches the lamp on.

The recorder begins to power up when the sounder is activated from the main panel. Capacitors C2 and C3 are wired in series to maintain a suitable voltage rating, and charge with current which is limited by resistor R5. They store power for subsequent operation of the recorder. There is a minimum charge time of several seconds for which the power must remain on in order to reach a sufficient voltage for the op-amps and permit illumination of the lamps L1 and L2. Diodes D4, D5 and D6 ensure that the capacitors feed only the op-amp circuits when power to the sounder and recorder is removed. Amplifiers having low quiescent current requirements (eg. MAX332) should be used to ensure that the lamps can remain illuminated for a sufficiently lengthy period of at least a few minutes after power removal.

Lamps L1 and L2 will be illuminated immediately on satisfactory operation of the sounder and may be configured to draw upon capacitors C2 and C3 as soon as the sounder is turned off, or to preserve the stored power until an observer has arrived at the recorder. If terminals T6 and T7 are connected, or terminals T8 and T9 are connected, then current will flow respectively from the sources I1 and I2 and continue until the capacitors C2 and C3 have discharged to a voltage below that required by the op-amps. This at least about 30 minutes in the circuit as shown. However, it is conceivable that the observer will not arrive before the stored power is exhausted and the lamps are turned off. If one or other or both pairs of terminals are not connected, the respective lamp currents will barely flow until button PB1 has been pushed by the observer. The capacitors discharge slowly over a period of approximately one hour which is normally ample for the observer to inspect each sounder and recorder in an entire fire alarm system during a test procedure.

Figure 3c shows the circuit of an optional rectification module which enables an event recorder to monitor ac devices. It also enables power to be stored in the recorder without operating the particular device. This can assist in reducing the length of time over which a potentially annoying device such as an annunciator is required to operate during a test procedure. The module is connected across the power supply to the device and to terminals T2 and T4 of the recorder.

Figure 4 is a block circuit diagram for a hand held tester which may be used to check the operation of an event recorder such as shown in Figure 3a or 3b. The tester is plugged or otherwise connected into the recorder at contacts TP1, TP2 and TP3 which are shown in

both figures. Once in place it may be operated manually through push-button controls 40 or remotely through a radio signal receiver 41 and output 42. A selector 43 and associated switches are used to enable either form of operation as required. Various tests may then be carried out on a recorder through interface 49 by choosing an appropriate setting on selector 44 as explained below. A battery power supply 45 energises the tester, and through a selector 48 applies appropriate voltage and current to the recorder and the annunciator or other device which the recorder has been installed to monitor. A charger 46 is connected to mains power through a terminal 47 and associated interlocked switches when the batteries are to be recharged.

One test applies supply voltage to the event recorder through TP1 and TP2, to check operation of the circuit relating op-amp A1, and also to the monitored device. This activates the device and illuminates the lamps L1 and L2 on the recorder if the required current and sound levels from the device are reached. The lamps should remain on for a short period after the supply voltage is removed, for subsequent observation as described above. The supply voltage and current can be checked by voltage/current meter 50 which is used for performance testing of the device in conjunction with sound level readings from nearby areas. A second test uses a calibrated sound source 51 and transmitter 52 to check the operation of microphone M1 and the circuit relating to op-amp A2. Output from the monitored device is disabled so that the microphone picks up only sounds produced by the tester.

The blocking diode D1 of the recorder can also be tested in both forward and reverse current flow directions. A positive going current is first applied from TP3 to TP1 as shown in Figure 3a. The current passes through a shunt and returns via interlocked contacts on the tester. A lamp illuminates if the diode is performs acceptably under forward bias and a measurement of the voltage and current is presented on meter 50. A negative going current is then applied to check that the diode is acceptable under reverse bias, or is at least open circuit. Once again an appropriate lamp is illuminated and a measurement of voltage and current is presented.

Figure 5 indicates a fire alarm system in which event recorders 20 were installed with the system itself rather than in a retrofit. Two of three event recorders are shown as integral parts of their respective annunciators 14, and another is shown installed separately. The event recorders are able to indicate acceptable test operation of their respective annunciator devices 14 directly on the main panel 11. This is achieved over lines 50 to corresponding responders 10 which in turn are normally able to communicate with the main panel as described above in relation to Figure 1. A simple digital signal is

transmitted on lines 50 in each case. The event recorders could also conceivably communicate directly with the main panel 51. Either way, information concerning the operation of each annunciator is thereby transferred to a suitable pictorial display 51 on the main panel. The circuit of Figure 3b may be modified in this system as the power storage by capacitors C2 and C3 will not normally be required.

My invention enables compliance of emergency warning systems with safety requirements or recommendations. It enables an alarm system such as a fire alarm system, to be tested on a regular basis without creating an unacceptable noise intrusion for occupants of a multistory office or apartment block, for example. Numerous versions of the invention will be possible within the scope of the following claims.

CLAIMS:

1. A method of testing an alarm system having annunciator devices such as sounders or speakers, comprising: installing event recorders to monitor at least some of the devices in the system, activating the system during a test procedure, detecting operation of the monitored devices with the respective event recorders, and inspecting each recorder to determine whether the respective monitored device has operated in an acceptable fashion.

2. A method according to claim 1 further comprising:
detecting operation of the monitored devices with their respective event recorders by detecting a physical output from the devices.

3. A method according to claim 1 further comprising:
detecting operation of the monitored devices with their respective event recorders by detecting current flow in the devices.

4. Event recorder apparatus for monitoring the operation of an annunciator device comprising: output detecting means which determines whether output from the device has reached a predetermined level and/or current detecting means which determines whether current flow through the device has reached a predetermined level, and indicating means which provides an indication for an observer as to whether the predetermined levels have been reached.

5. An event recorder according to claim 4 wherein the physical output detecting means comprises a microphone for detecting sound level output by the device.

6. An event recorder according to claim 4 wherein the indicating means comprises a light emitting diode which is illuminated on acceptable operation of the remotely operating device and remains illuminated for half an hour or more after the device has ceased operation.

7. An annunciator for an emergency warning system, including an event recorder for monitoring operation of the annunciator, wherein the event recorder monitors a physical output of the annunciator and/or current drawn by the annunciator, and generates an indication of whether or not the annunciator has operated acceptably during activation of the emergency warning system.

8. An annunciator according to claim 7 wherein the event recorder monitors audible output of the annunciator by way of a microphone.

9. A annunciator according claim 7 wherein the event recorder generates a visible indication of acceptable operation of the annunciator, for inspection at the annunciator itself.

10. A annunciator according to claim 7 wherein the event recorder generates an indication signal for transmission to a control panel located elsewhere in the emergency warning system.

11. An emergency warning system having annunciators and event recorders which monitor operation of respective annunciators, wherein the event recorders provide an indication of whether the annunciators have operated acceptably during a test procedure, and either provide their indications for subsequent inspection at the annunciators, or transmit respective indication signals to a control panel.

12. An emergency warning system wherein at least some of the event recorders are integral with respective annunciators.

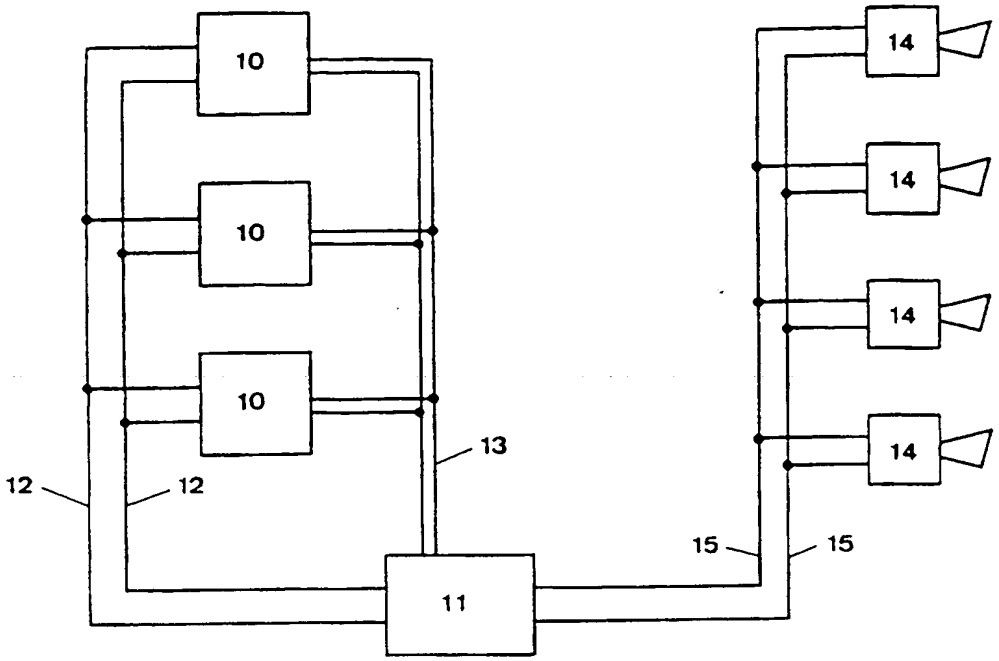


Figure 1

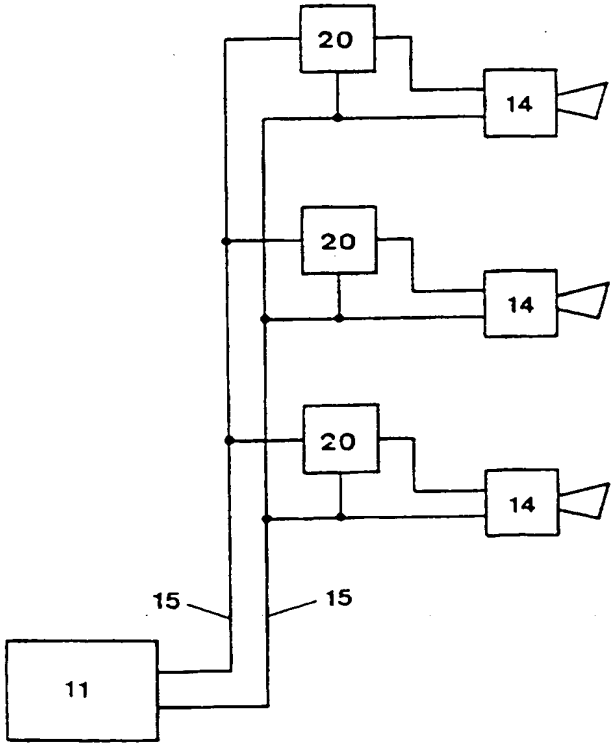


Figure 2

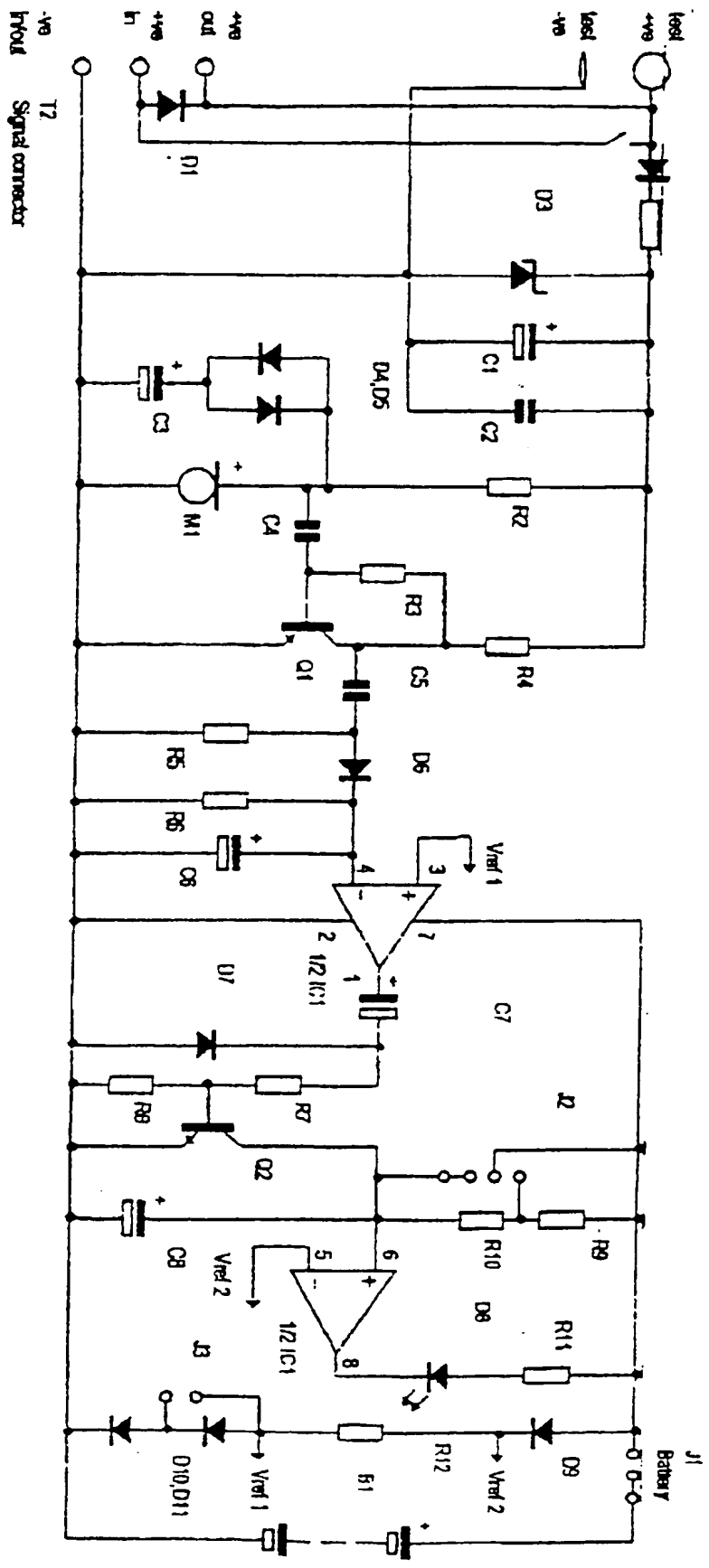
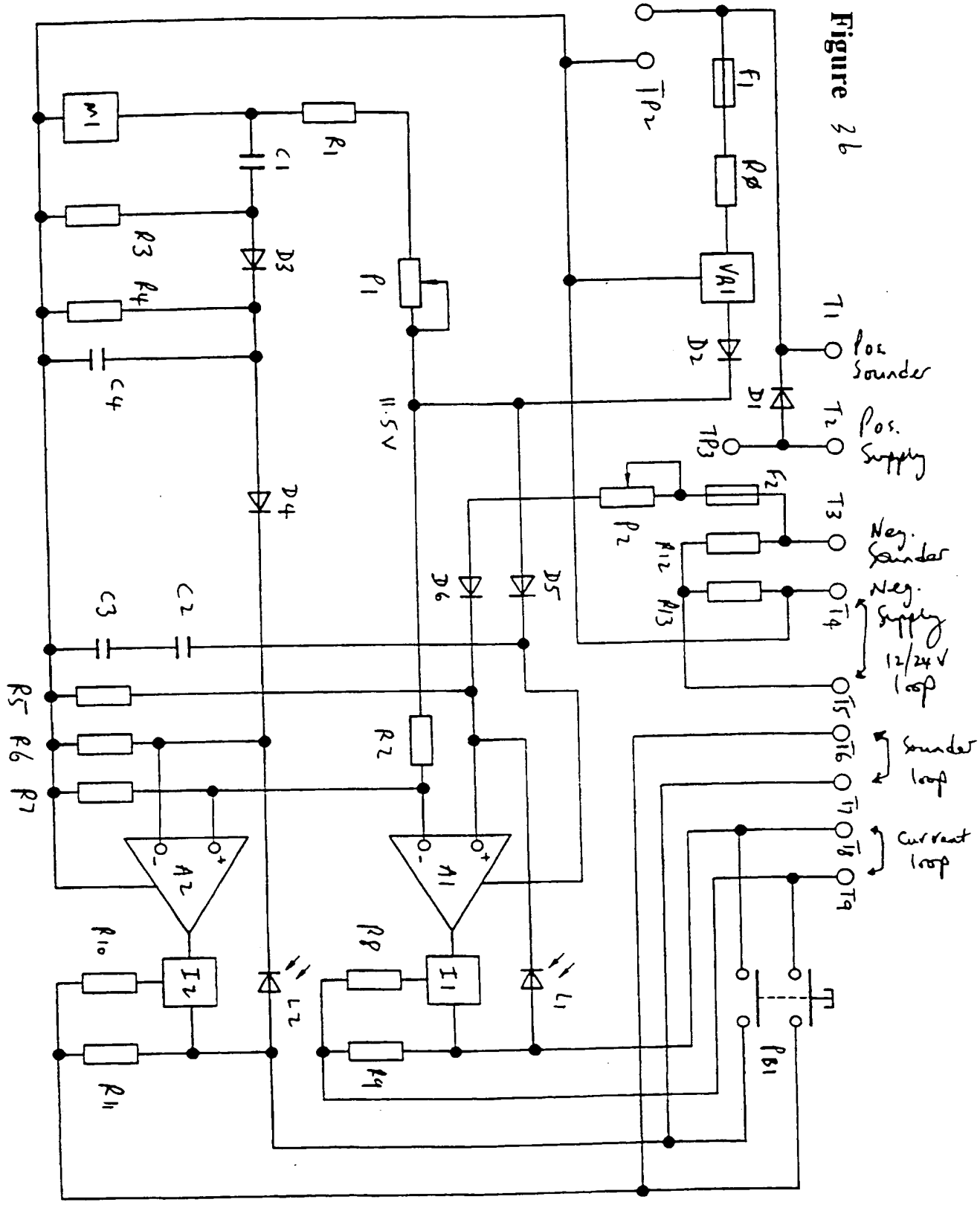

T1
Teal connector
Teal +ve
Teal -ve
T2
Signal connector
-ve Input
+ve In
+ve Out
D1
D2
D3
R1
C1
C2
C3
D4,D5
M1
C4
R2
R3
Q1
C5
R4
R5
D6
R6
C6
Vref 1
U1
1/2 IC1
C7
R8
R7
Q2
J2
C8
Vref 2
R10
R9
J3
1/2 IC1
D8
R11
D10,D11
Vref 1
F1
R12
Vref 2
D9
J1
Battery

Fig 3a

Figure 2b


TP2
F1
RØ
VA1
D2
D1
T1
Pos Sounder
T2
Pos. Supply
TP3
F2
T3
Neg. Sounder
T4
Neg. Supply
12/24V loop
T5
T6
Sounder loop
T7
T8
Current loop
T9
M1
R1
C1
R3
D3
R4
C4
P1
11.5V
D4
P2
R12
R13
D6
D5
C3
C2
R5
R6
R7
R2
A2
A1
R10
I2
L2
RP
I1
L1
R11
R9
PB1

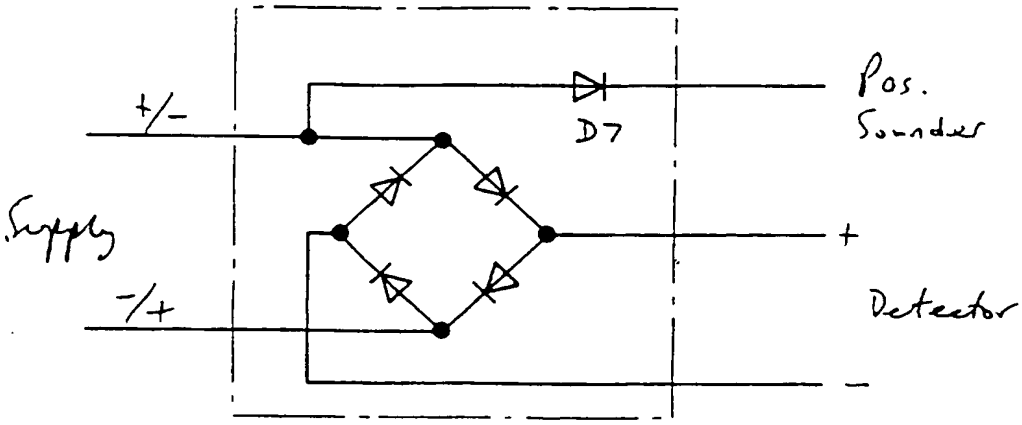


Figure 3c

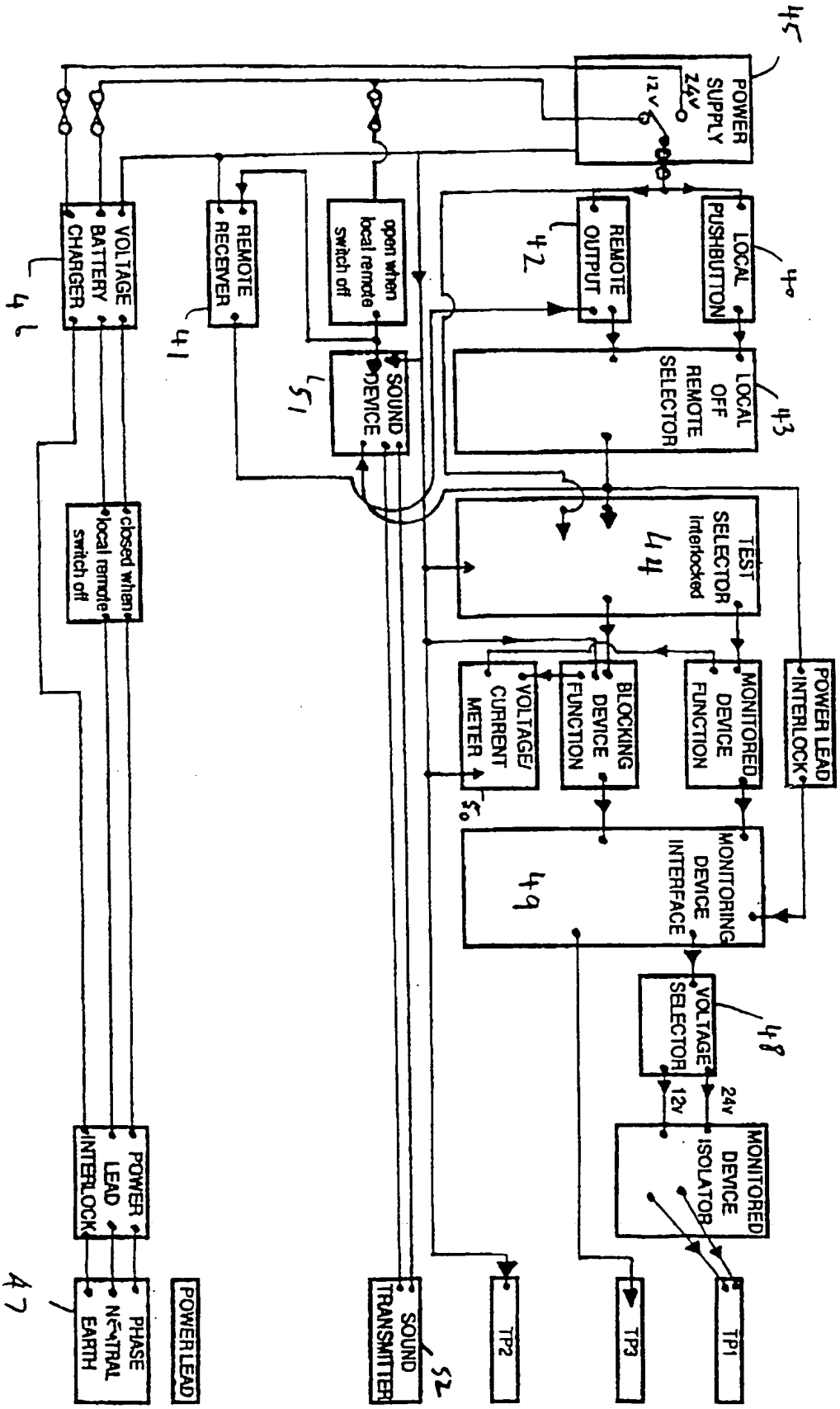

45
POWER SUPPLY
12V
24V
LOCAL PUSHBUTTON
40
REMOTE OUTPUT
42
LOCAL OFF REMOTE SELECTOR
43
TEST SELECTOR Interlocked
44
POWER LEAD INTERLOCK
MONITORED DEVICE FUNCTION
BLOCKING DEVICE FUNCTION
VOLTAGE/ CURRENT METER
50
MONITORING DEVICE INTERFACE
49
VOLTAGE SELECTOR
48
MONITORED DEVICE ISOLATOR
12v
24v
TP1
TP2
TP3
SOUND TRANSMITTER
52
SOUND DEVICE
51
open when local remote switch off
REMOTE RECEIVER
41
VOLTAGE BATTERY CHARGER
46
closed when local remote switch off
POWER LEAD INTERLOCK
47
PHASE
NEUTRAL
EARTH
POWER LEAD

Figure 4

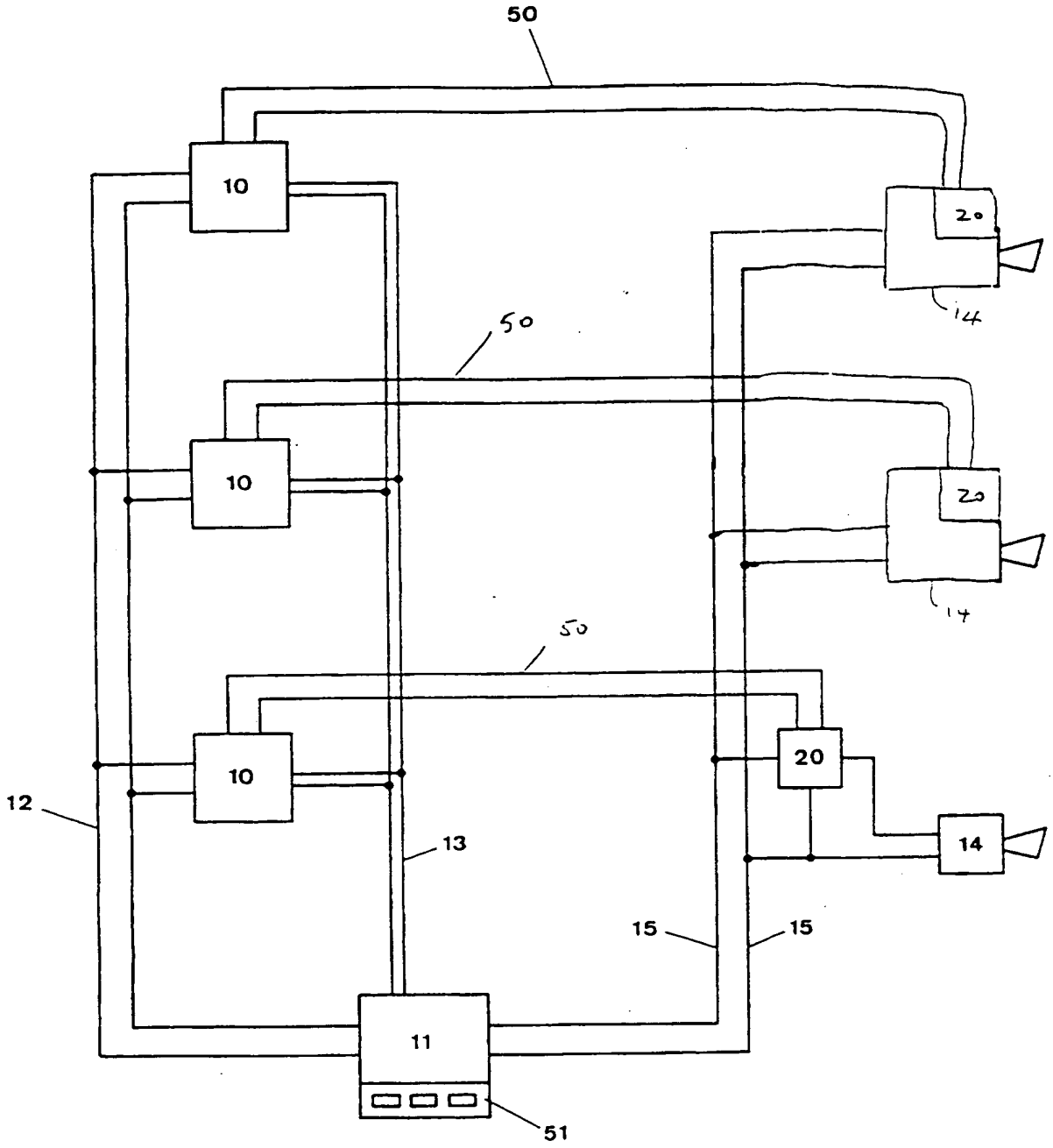


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ97/00099

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G08B 29/10,12
US CL :340/514
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/514-516

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, JPOABS, EPOABS
search terms: alarm?, annunciat?, test?, monit?, event#, record?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,977,527 A (SHAW et al) 11 December 1990, Abstract, Fig. 14B, col. 3, line 14- col. 4, line 28	1-12
Y	US 3,603,986 A (HARRIS) 07 September 1971, Abstract, Fig. 1	1-12
A	US 3,512,147 A (MARTIN) 12 May 1970	1, 4, 7, 11
A	US 3,676,878 A (LINDER) 11 July 1972	1, 4, 7, 11
A	US 4,258,357 A (BROWELL) 24 March 1981	1, 4, 7, 11

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search
05 DECEMBER 1997

Date of mailing of the international search report
29 JAN 1998

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Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ97/00099

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2054923 A (WHITE) 18 February 1981	1, 4, 7, 11
A	JP 53-9498 A (HITACHI SEISAKUSHO K.K.) 27 January 1978	1, 4, 7, 11

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